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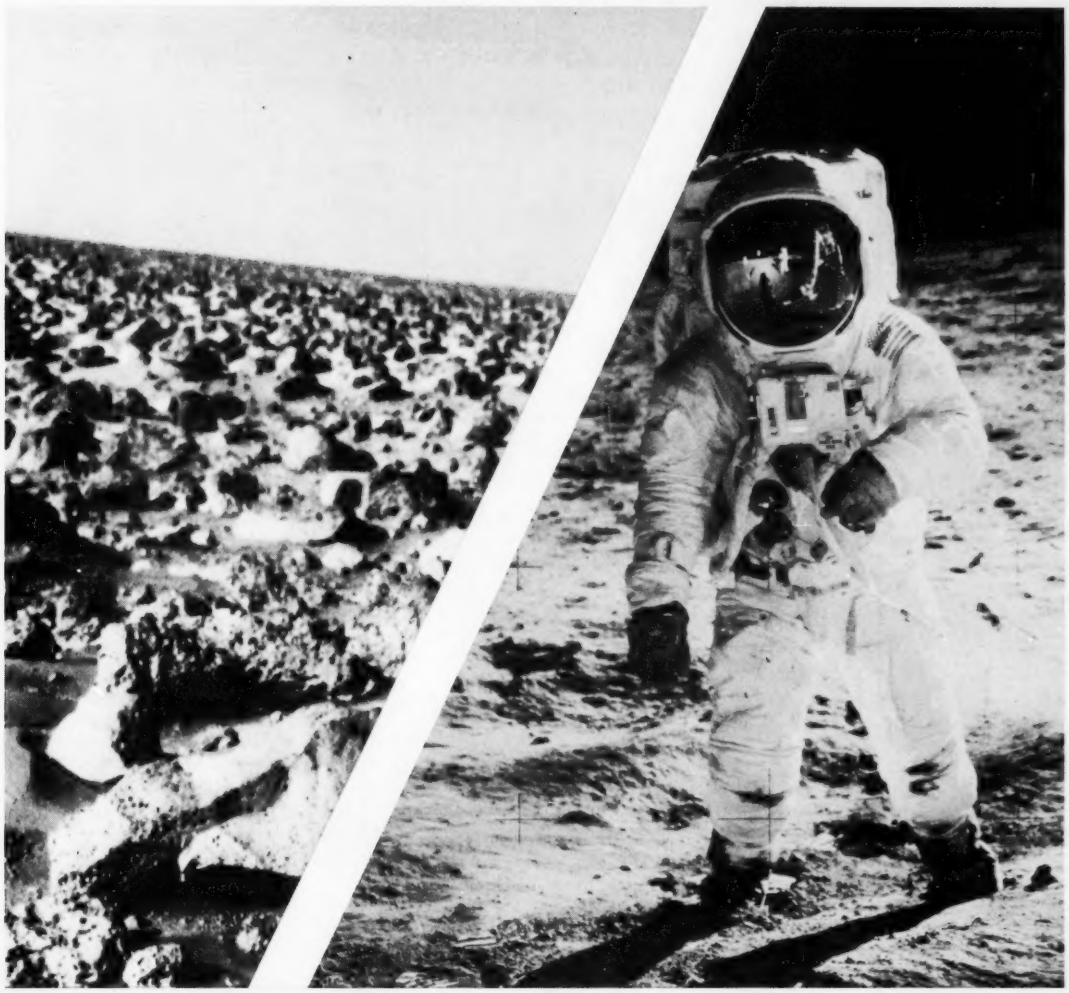

About the Cover

On Sunday, July 20, 1969, at 10:56 p.m. EDT, NASA astronaut Neil A. Armstrong, commander of Apollo 11, became the first man to set foot on the surface of the Moon. With the lunar landing of the Apollo 11 spacecraft, America had won nearly a decade-old space race to the Moon. Armstrong's step from the Lunar Module to the Moon's surface—described by him as ". . . one small step for man, one giant leap for Mankind"—represented the climax of a national space effort that begin in May 1961 and involved, at its peak, more than 300,000 individuals in industry, universities, and government.

On the cover (right), is astronaut Edwin E. "Buzz" Aldrin, lunar module pilot for Apollo 11, photographed by mission commander Neil Armstrong, as he walked near the Lunar Module during an extravehicular activity (EVA).

Apollo 11 was the first manned lunar landing of the Apollo program, touching down in the planet's Sea of Tranquility. During the 8-day mission, July 16-24, 1969, one lunar EVA was performed totalling 2 hours, 48 minutes, and 46 pounds of lunar samples were collected.

The date July 20 also was to record another historic event seven years later—the landing of the Viking 1 spacecraft on the surface of Mars on July 20, 1976. Viking 1, consisting of an orbiter and a lander was launched to Mars on Aug. 20, 1975, and arrived at the Red Planet June 19, 1976; Lander 1 touched down on the surface of Mars one month and one day later, on July 20, at a site 22.3 degrees North latitude and 48 degrees West longitude on the western slope of Chryse Plantia, the "Plains of Gold."

Viking 1 Lander (renamed the Mutch Memorial Station) operated for 2,245 Martian days (6 years, 108 Earth days) until communication with Earth was lost; last contact occurred Nov. 13, 1983. Viking 1 transmitted more than two million Martian weather reports during its lifetime and, in concert with Viking Lander 2, took more than 4,500 photos of the Martian surface, and mapped 97 percent of the planet's surface with a resolution of 300 m (1,000 ft.) or better, and 12 percent of the planet's surface with a resolution of 25 m (82 ft.). Photo at left shows boulder-strewn field of red rocks stretching before Viking Lander 2 on Mars' Utopian plain. For more on the Viking story, see pages 3-7 of this issue.

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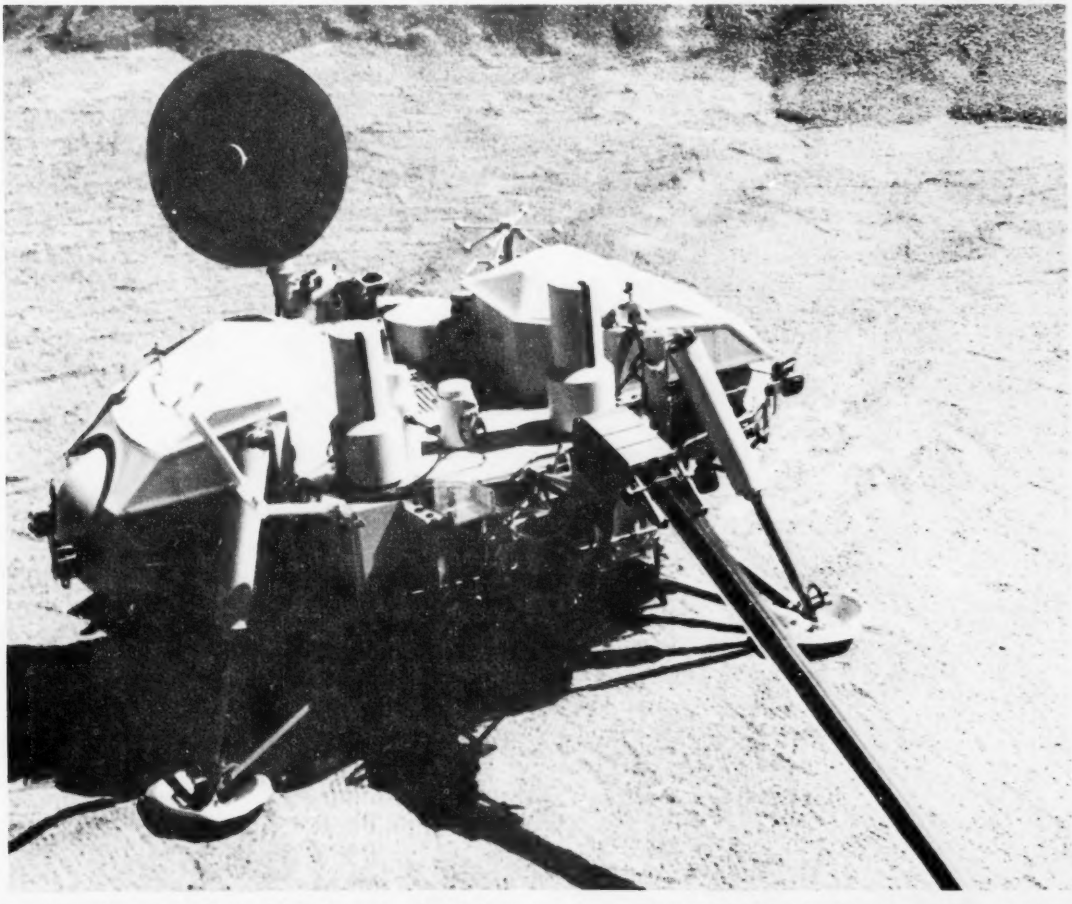
Viking—A Martian Era Comes to an End

The culmination of over a decade of science missions to Mars occurred on Nov. 13, 1982 when NASA's communications with Viking Lander 1, stationed on Mars in an area designated the "Plains of Gold," suddenly came to an end. Despite repeated attempts from Dec. 1982 through May 1983 to contact the last operative spacecraft of the Viking mission, NASA failed to reestablish signals from the Lander, bringing to a close one of the space agency's most productive planetary programs.

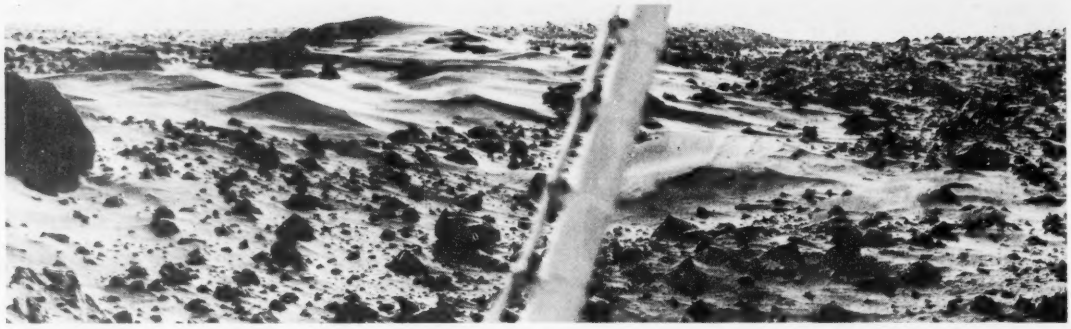
In Jan. 1981 Viking Lander 1 was renamed the Mutch Memorial Station as a tribute to the memory of Dr. Thomas A. Mutch, former Viking Lander Imaging Team Leader and former Associate Administrator of NASA's Office of Space Science. Dr. Mutch disappeared during an attempt to climb Nun Jun, a peak in the Himalayas in Sept. 1980.

What caused the sudden failure in the Mutch Memorial Station is unknown. NASA's final opportunity to try and reactivate the Lander was on May 22; the procedure, the last of three separate attempts, ended unsuccessfully as engineers transmitted a final set of commands to the Lander that exhausted all possible modes designed to fix probable failures with the spacecraft. No attempt to re-establish contact resulted in any kind of downlink response.

The more than five months of silence from the spacecraft have caused NASA officials to conclude that contact cannot be re-established with Mutch Memorial Station.



Full size working model of Viking Lander sits on simulated Martian surface landscape at NASA's Jet Propulsion Laboratory, Pasadena, Calif. The spacecraft measures approximately 1.5 meters (5 feet) in diameter and about 0.5 m (1.5 ft.) high and weighs about 890 kilograms (1 ton). The soil sample collecting arm (lower right) measures about 3 m (10 ft.).



Variety in Martian surface captured by cameras on Mutch Memorial Station. This view of the Red Planet covers a horizontal angle of about 100 degrees. Martian northeast is at left; southeast at right. Large boulder at left, named Big Joe, measures 1 × 3 meters (3 × 10 feet) and is 8 m (25 ft.) from the Lander.

The Viking project was comprised of two orbiters and two landers, identical in nature and engineered as the most sophisticated planetary spacecraft ever developed. Their summer 1975 launch marked the last of a series of missions to Mars that began in 1964 with Mariner 4, and continued with the Mariner 6 and 7 flybys in 1967 and the Mariner 9 orbiting mission in 1971 and 1972. NASA has no approved plans within this decade to initiate new Mars missions; however, NASA's Space Science Exploration Committee has recommended that a Mars Geoscience/Climatology Orbiter be scheduled for launch in 1990, the first to use the new proposed Planetary Observer spacecraft (see NASA Activities, June 1983 edition, pgs. 9-10.)

For approximately 6½ years, Mutch Memorial Station successfully transmitted weather and photographic data to Earth. The spacecraft had performed flawlessly beyond its expected operational lifetime of 90 days since its touchdown on the Red Planet in 1976.

During its lifetime of 2,245 Martian days (6 years, 115 Earth days), this Lander transmitted more than 2 million Martian weather reports and, in conjunction with Viking Lander 2, took a total of 4,500 photographs of Martian surface features.

Viking Orbiters 1 and 2 observed Mars for two Martian years (4 Earth years) with cameras monitoring the planet's weather patterns and dust storms. The Orbiters took 52,663 photographs of Mars before their respective operations ended; their combined data was used to map 97 percent of the surface of the Red Planet with a resolution of 300 meters (1,000 feet) or better and 12 percent of the planet with a resolution of 25 meters (82 feet) or better.

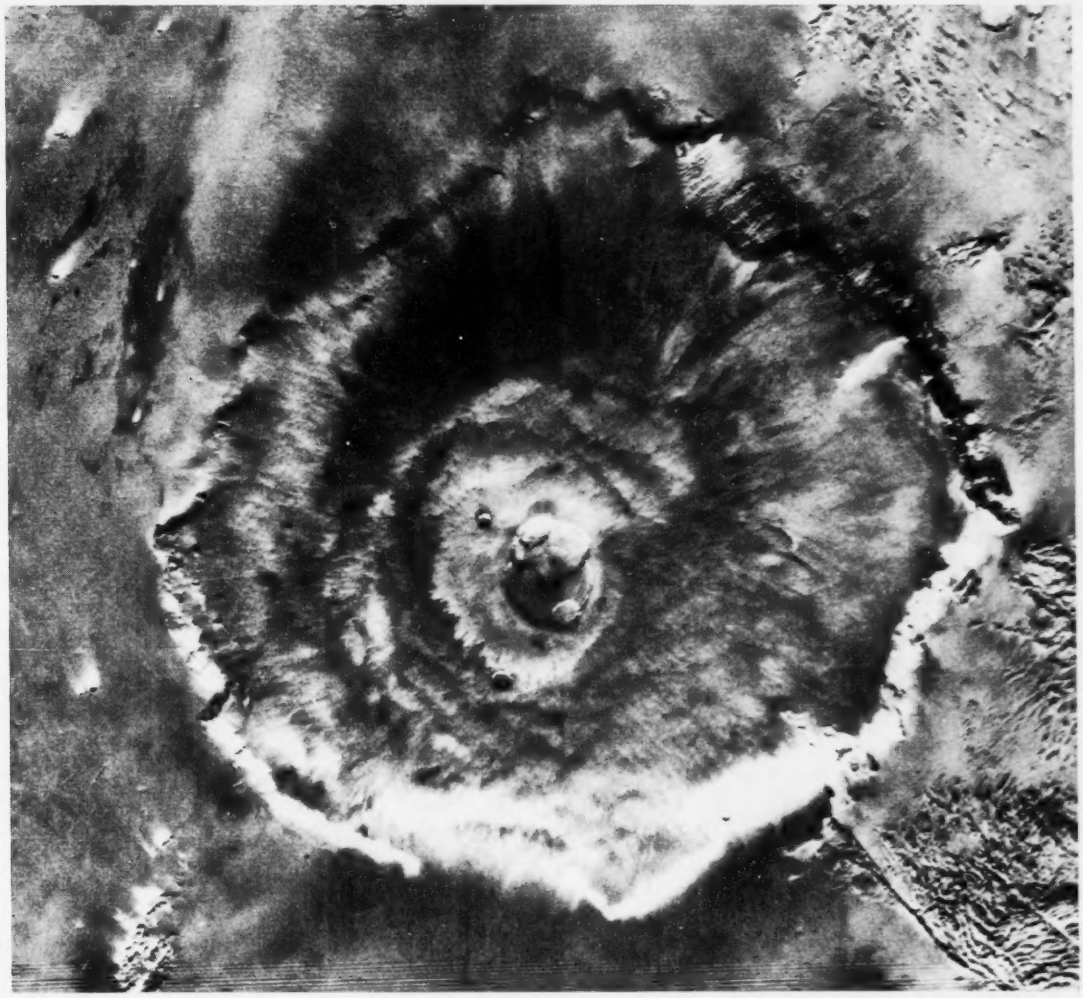
The twin Viking orbiter-lander spacecraft were launched in the summer of 1975: Viking 1 on Aug. 20 and Viking 2 on Sept. 9. The landers were sterilized before launch to ensure they would not contaminate either Mars or their own biology experiments with terrestrial organisms. Viking 1 arrived at Mars on June 19, 1976, and Lander 1 touched down on the planet's surface on July 20—seven years after Apollo 11 reached the Moon. Viking 2 arrived at Mars on Aug. 7 and landed on Sept. 3. Viking Lander 1's site was at 22.4 degrees north latitude and 48.0 degrees west longitude on the western slope of Chryse Planitia, the "Plains of Gold." Viking 2 landed at 47.7 degrees north latitude and 225.8 degrees west longitude at Utopia Planitia—the "Utopian Plains."

Viking Orbiter 2 was the first craft to be turned off on July 24, 1978, after being in orbit for 718.8 days, the spacecraft expended the last of its attitude-control gas. Viking Orbiter 1 was silenced Aug. 7, 1980, after orbiting Mars for 1,509.9 days, also because its attitude-control gas had been depleted. The last data from Viking Lander 2 reached Earth April 11, 1980, 1406.1 days after it landed. By that time, the spacecraft had transmitted one million Martian weather reports to Earth.

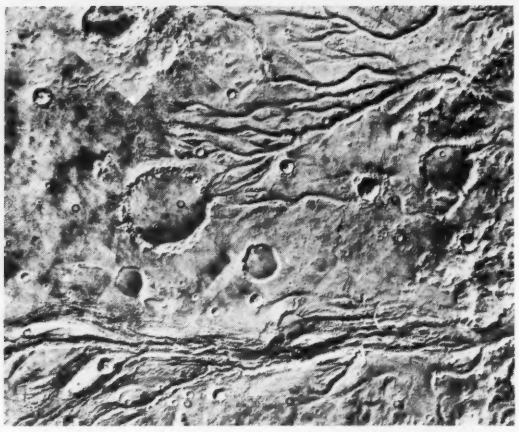
The Viking orbiters housed two cameras, a water-vapor mapper and an infrared thermal mapper. Experiments using the spacecraft telemetry system measured microwave scattering properties of the Martian surface; permitted refinement of the orbit and mass of Mars; measured electron concentration between Earth and Mars and estimated the electron density of Mars' ionosphere. According to Joe Brenkle, former Viking radio science team leader, the Viking lander and orbiter ranging instruments may have made the most precise distance measurements in the history of mankind. "This observational data has provided the most accurate test of Einstein's General Theory of Relativity to date, as well as providing some very useful celestial mechanics observations for the navigation of not only future spacecraft but even for ships at sea," said Brenkle.

Perhaps the most important search conducted by the Viking Landers was the search for life—evidence of living organisms and organic molecules on the Martian surface. Here the scientific data results were ambiguous and were debated for several years. Although the general concensus from the experiments indicated that Mars is a dead planet, the question of life on Mars, according to Viking biologists, remains an open one. Three of the results from the biology experiments indicated the absence of biology in the samples tested. However, one result indicated the Martian soil has either an agent capable of rapidly decomposing organic chemicals or, improbably, that life is present. The soil did not, however, contain any organic molecules that were detectable at the parts-per-billion level.

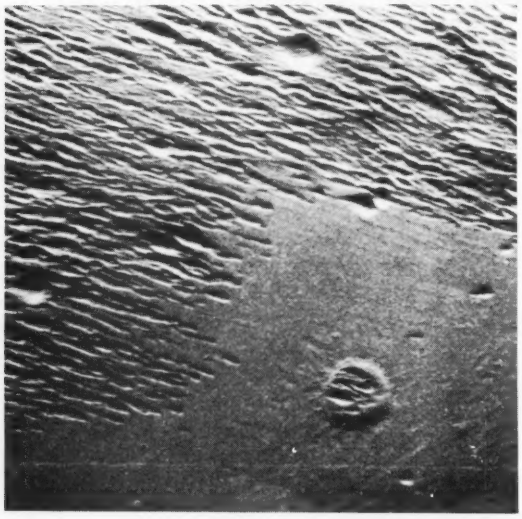
The Viking cameras observed a wealth of Martian topographic features: close-ups of the summit caldera of the largest known volcano in the solar system—Olympus Mons; Valles Marineris, a 3,000-mile-long rift valley that would reach from the Atlantic to the Pacific Ocean across the middle of the United States. Viking's orbiter cameras photographed



Mars Olympus Mons, the largest known volcano in the solar system, measures 27 kilometers (17 miles) high and is surrounded by a circuit cliff 500 km (300 mi.) across. By comparison, Hawaiian volcanoes, the largest on Earth, measure 120 km (75 mi.) across at their bases on the ocean floor.



Cameras in Viking Orbiter 1 photographed a maze of wandering channels that cut across the terrain west of the Mutch Memorial Station site. Flood waters once poured across this region from left to right, cutting through high ridges to pour out onto plains in the East.



Martian dunes in an area approximately 20 kilometers (12 miles) across, elongated in the direction of the wind. Most of surface sand material found at Viking Lander sites and blown around the planet in dust storms is very fine grained and could not form dunes. Scientists hypothesize that the Martian particles may stick together electrostatically or are bound together in ice to form grains large enough to form dunes.

surface features that appeared to have been cut by great flood of running water; and recorded the development and dissipation of dust storms and the erosive effects of strong winds.

Lander 2 photographed frost on the ground during the Martian winter. Both looked at huge boulders a few meters from the lander, small areas where soil slid and growing layers of dust dropped on the lander by the thin, chill Martian wind.

Viking's instruments indicated that Mars is drier than any spot on Earth, more arid than the Sahara or Gobi deserts, or the Antarctic dry valleys, our planet's driest region. We learned the Red Planet contains some water. Some amounts are trapped as vapor in the thin, dry, predominantly carbon dioxide atmosphere, but most is probably trapped in soil beneath the surface.

The solar ultraviolet flux at the surface of the planet is apparently so strong that it, evidently, could break down any organic compounds that might plunge to the ground in meteorites. The soil is rich in iron oxides—the rust that gives Mars its distinguishing color. The planet was named after the Roman war god because of its angry, red appearance in the night sky.

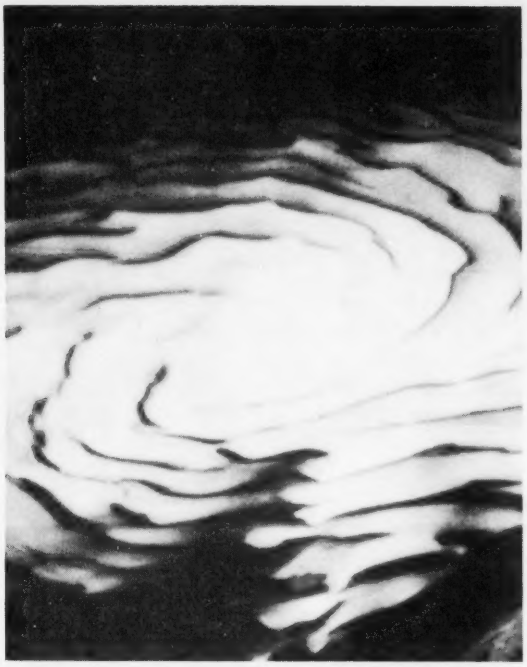
Mars' poles are covered, the entire year with ice caps. The northern residual cap that remains on the ground through the summer is water ice, while that of the southern pole combines water ice with much colder frozen carbon dioxide.

Much of the time the weather on Mars is uniform and dull, changing very little from day or season to season. The daily low temperature at the southern landing site dropped to –124 degrees Celsius (–191 degrees Fahrenheit), while the summertime high soared to –31 degrees C (–24 degrees F).

Though the wind blows on Mars most of the time, it is generally not as strong as scientists had predicted. Neither lander recorded a gust stronger than 120 kilometers (74 miles) an hour and the mean velocities were much lower. However, violent global scale dust storms and frequent local dust storms originate near the edge of the retreating polar cap.

The Viking mission has enabled scientists to throw light on many of the mysteries of Mars—fourth planet from the Sun. George Gianopolus, the current Viking Project manager at NASA's Jet Propulsion Laboratory, summed up the Viking mission and expressed feelings shared by nearly everyone involved with the project: "One of the biggest thrills in my life was that memorable day when Lander 1 touched down successfully and the first two surface pictures came across the television screen. A lifetime of wondering what Mars really looked like came to an end with that first panorama scene of Mars."

NASA's loss of Mutch Memorial Station signifies not only the end of a program, but the loss of the space agency's first semi-permanent geological and meteorological observatory stationed on a distant planet.



Oblique view of residual northern polar cap on Mars. Both poles of the planet have caps that advance and recede with the seasons. Dark lines are mostly valleys or southward facing escarpments that are free of frost.

Martian storm fronts; clouds form in Mars atmosphere much as they do on Earth and resemble Earth clouds in appearance. However, cloud composition differs; Earth clouds are composed mostly of water or water ice. Martian clouds above the polar caps are made up of carbon dioxide. Clouds on Martian volcano slopes or storm fronts are water or water ice.

NASA's Langley Research Center in Hampton, Va., was assigned management responsibility for the Viking project from its inception in 1968 until April 1, 1978, when this responsibility was assumed by NASA's Jet Propulsion Laboratory, Pasadena, Calif. The landers were developed under contract by Martin Marietta Aerospace, Denver. NASA's Lewis Research Center, Cleveland, had responsibility for the Titan-Centaur launch vehicles. JPL's initial assignment was development of the orbiters, tracking and data acquisition, and the Mission Control and Computing Center.

IRAS Discovers New Comet

Scientists working on the international Infrared Astronomical Satellite (IRAS) project have discovered a new comet which has been named IRAS-Araki-Alcock, for the observers who reports its discovery. Genichi Araki is a Japanese amateur astronomer and G.E.D. Alcock is a British amateur astronomer. They reported sighting the comet simultaneously with the IRAS science team.

Comet IRAS-Araki-Alcock first appeared in data transmitted to Earth on April 25 in IRAS' routine search for asteroids. When it was photographed later by ground-based telescopes, the object was identified as an extremely fast-moving comet.

This marks the first time a comet has been discovered using an instrument that measures temperatures, rather than visible light. It also is the first time a comet has been seen at far-infrared wavelengths, where very cold objects emit most of their radiation.

The new comet made its closest approach to Earth on the evening of May 10. The accumulated brightness of the entire comet equalled that of the brightest stars in the sky, but because its light was spread over an area 16 times greater than the area of the Moon, it was difficult to see with the unaided eye. The comet passed about 5 million kilometers (3.1 million miles) from Earth—12 times farther from Earth than the Moon is. Only one other comet has been known to approach closer to Earth.

At the time of its discovery by IRAS, comet IRAS-Aracki-Alcock was about 90 degrees from the Sun. It was too dim to be seen with the unaided eye, the IRAS scientists said, although it was extremely bright in the IRAS infrared telescope.

The Infrared Astronomical Satellite is a joint project NASA, the Netherlands Agency for Aerospace Programs, and the British Science and Engineering

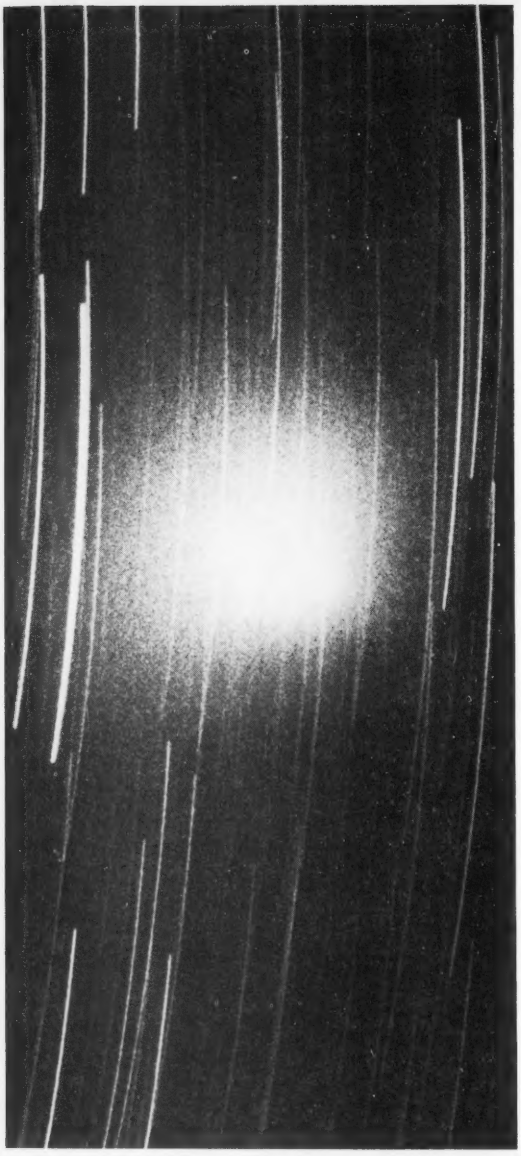


Photo of new comet IRAS-Araki-Alcock taken May 9 by James Young of NASA's Jet Propulsion Laboratory, Pasadena, Calif. The exceptionally fast-moving comet came closest to Earth on May 10, en route to the closest approach to the Sun on May 21. The comet is the bright, diffuse object; the bright lines are stars that appear to move as the telescope tracked the comet.

Research Council. NASA's Jet Propulsion Laboratory, Pasadena, Calif., is the U.S. management center. Data from IRAS are received at the ground station at Chilton, England.

JPL Research Leads to Possible Cancer Breakthrough

Biomedical techniques developed at NASA's Jet Propulsion Laboratory, Pasadena, Calif., may offer new hope in a cancer treatment breakthrough for victims of neuroblastoma—a cancer that most commonly attacks the bone marrow of children and young adults. Neuroblastoma occurs in approximately one of every 100,000 children and has a mortality rate of approximately 50 percent.

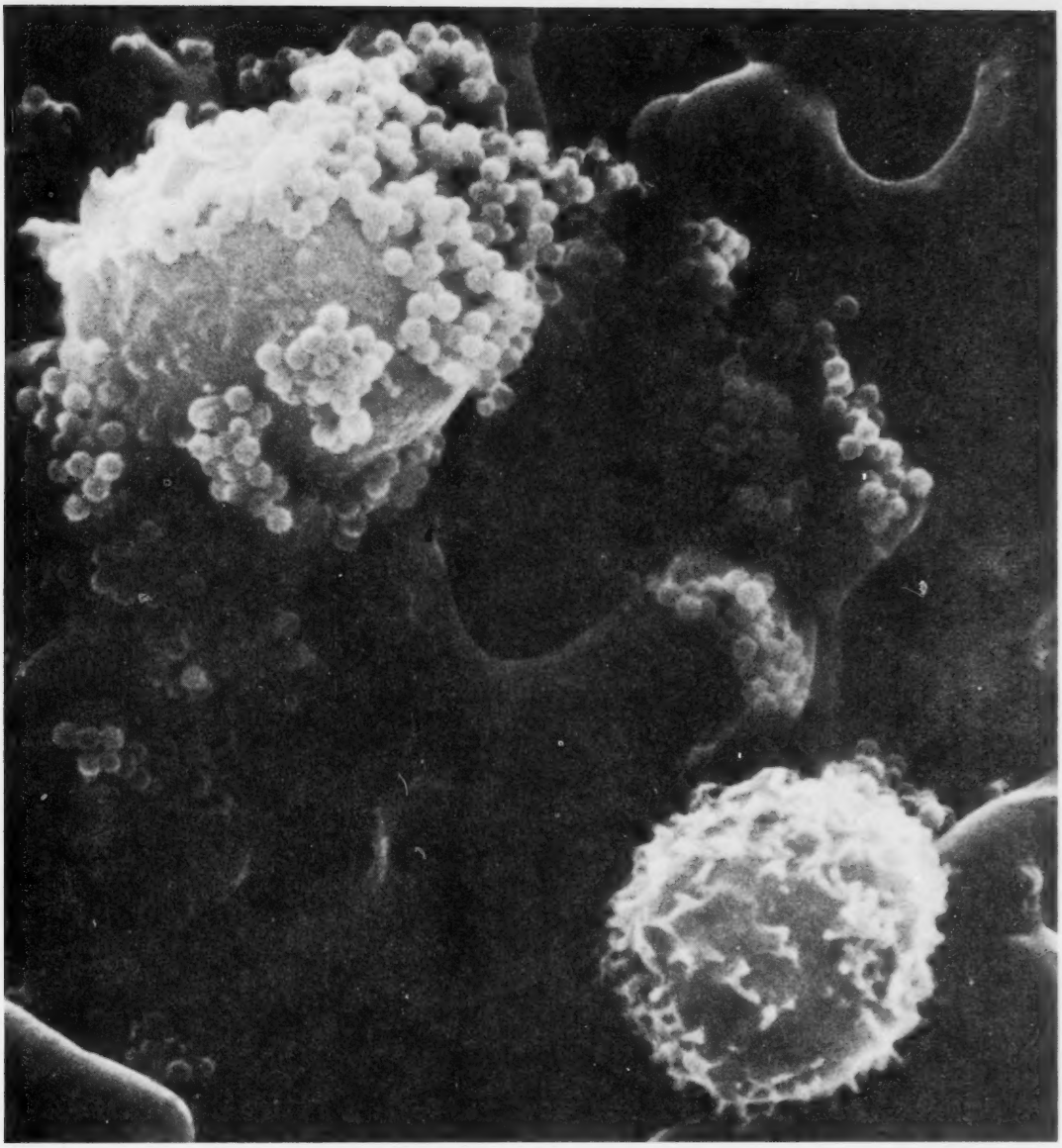
The new treatment combines chemotherapy with a new method that removes cancerous cells from bone marrow using magnetic attraction. The magnetic technique was developed by JPL's Dr. Alan Rembaum; biochemist John T. Kemshead, Imperial Cancer Research Fund, London; and chemist John Ugelstad, University of Trondheim, Norway.

Although the new treatment is still in experimental stages, the process has been used in London to treat two patients suffering from neuroblastoma—a 23-year old English man and a 10-year old Irish boy, and their progress thus far has been encouraging. In this treatment, a small portion of cancer-inflicted bone marrow (about 10 percent) is removed from the patient. While the patient receives chemotherapy to kill the remaining cancerous cells, the removed bone marrow is treated with tiny magnetic microspheres, about three microns in diameter, composed of a material called polystyrene. At the core of this material is magnetite, coated with an antibody that attaches itself to the antibodies on cancerous cells.

The removed bone marrow also is mixed with antibodies that will attach themselves to cancerous cells. When combined, the two types of antibodies attract, with the magnetic microspheres attaching themselves to the cancerous cells in the bone marrow.

The mixture of marrow and microspheres is passed through a glass tube surrounded by samarium cobalt magnets. The magnets attract the magnetite in the spheres and hold the cancerous cells against the sides of the tube while the healthy cells pass through. This process is repeated to ensure that all the cancerous cells have been removed. Laboratory tests of the purity of the bone marrow after this process have found the marrow to be 99.9 percent pure or free of cancerous cells. Marrow at this level of purity is then returned to the body where it soon returns to its normal immunological functions of producing new red blood cells and fighting infection.

Rembaum has investigated the synthesis and properties of various plastic microspheres for 10 years.



Magnetic microspheres at work. Cancerous cell at upper left in the photo is covered with tiny antibody-coated magnetic microspheres that will separate it from the healthy white blood cell in the lower right that remains free of any spheres.

He carried out basic 'mmunomicrosphere research leading to the separation procedure largely at NASA's Jet Propulsion Laboratory, under the sponsorship of both the National Institutes of Health and the NASA Office of Technology Utilization.

Rembaum's initial research goal was to produce pure strains of cells for laboratory use. But recognition of broader medical applications led to the development of the current procedure by Kemshead and Ugelstad. Rembaum spent two months on leave from JPL in 1981

to work with Dr. Kemshead to refine the surgical procedure using magnetic technique. He is continuing his research at JPL using the properties of microspheres as applied to the biological sciences, on a basic grant from the National Institutes of Health.

"As far as I am aware, this is the first time magnetic microspheres have been used to remove cancer cells from bone marrow that is returned to a patient," said Rembaum. According to Dr. Beckenbach, manager of the Biomedical Research Program at JPL, researchers eagerly await acceptance of this procedure in the United States. "This technique may well result in an impressive step against diseases such as cancer in only a small number of years," said Beckenbach. "I think it's possible that ours will be the last generation that will die from cancer," he said.

As yet, neuroblastoma is the only cancer type for which the magnetic microspheres technique may be used. "Due to lack of funding we haven't been able to investigate biocompatibility or the microspheres relation with any other forms of cancer," said Beckenbach. "In general, research over the last few years has been in the basic ways that you make microspheres and in discovering their properties. We are only equipped to look at their application right now."

But the future for the magnetic microspheres is optimistic. "I see no reason why the microspheres cannot be used to deliver drugs and such to various parts of the body," said Beckenbach. "One of the main problems with present cancer treatments is that you just can't treat the bad cells. The drugs reach all of the cells, good and bad alike, so you end up destroying healthy ones in the process."

Other possible medical applications for the magnetic microspheres process includes diagnostic testing; separation and purification of proteins; and identification and labeling of cell membranes and the mechanisms of drug action.

NASA's Participation in Oshkosh '83

The 31st Annual Experimental Aircraft Association International Fly-in Convention and Sport Aviation Exhibition will be held in Oshkosh, Wisconsin July 30 through August 6. NASA's participation in this event has been organized under the theme "NASA: The Leading Edge of Technology." The overall goal of NASA's participation in Oshkosh '83 is to inform both the technical and general public of the agency's research and advances in the field of aeronautics—achievements that have enabled the United States to maintain its position in the forefront of world aviation.

Oshkosh is the world's largest annual aviation event and for the eight days of the exhibition, Wittman field at Oshkosh, Wisconsin becomes the world's busiest airport, nearly four times busier than Chicago's O'Hare air field, by comparison. Experimental Aircraft Association officials estimate that participation in the 1983 event, sponsored under the overall theme of "Wings on Dreams" should equal, if not exceed, the 1982 exhibition whose theme was "Salute to NASA Aeronautics." Last year's event broke previous convention records by attracting approximately 750,000 admissions, which included 1,163 foreign visitors from 56 countries and 40,000 campers. Almost 14,000 aircraft of all types and descriptions flew in to the event; 1,818 show planes were registered—over 200 more than had registered in 1981.

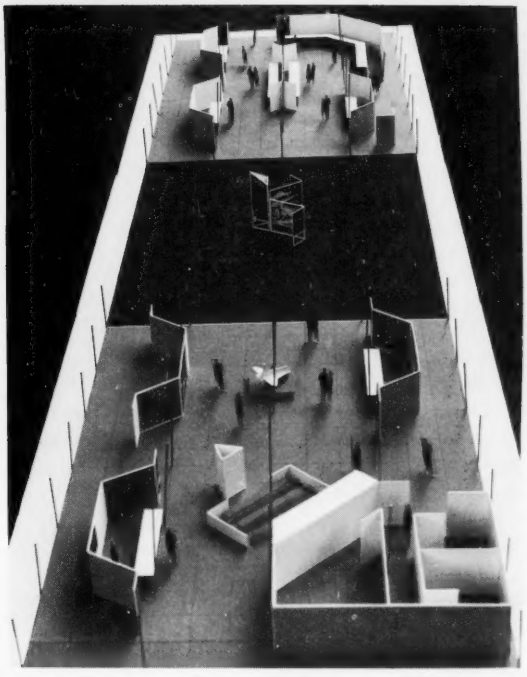
For the 1983 event, NASA aeronautics will feature two 60 × 90 foot exhibits, one designated as a technology exhibit area and the other as a public services tent. In addition, NASA will erect a 20 × 20 foot tent for use as a press headquarters.

The NASA technology tent will be divided into six areas of display: aerodynamics; propulsion; electronics and flight management; materials and structures; safety; and craftmanship.

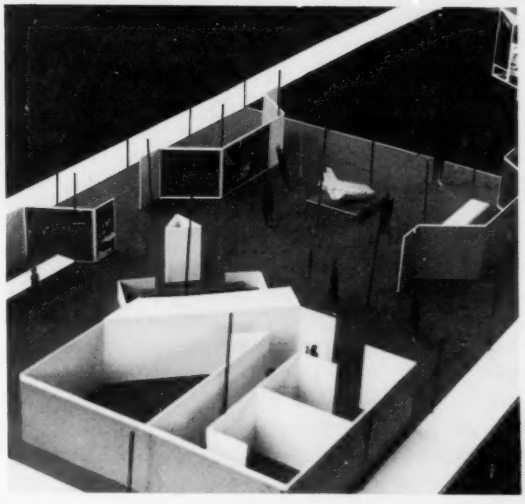
The aerodynamics exhibit will focus on laminar flow, airfoil research, flutter, and stall-spin phenomenon. The concept of laminar flow will be backdropped by profile drawings of airfoils and photographs illustrating flow studies in a wind tunnel. To illustrate airfoil research, models of current airfoil shapes used on certain types of general aviation aircraft will be displayed. The concept of aircraft wing flutter will be illustrated, accompanied by explanations on how such periodic vibrations could set off destructive forces in an aircraft. Exhibits on stall-spin research will focus on spin tunnel models, free-flight radio controlled models, and flight tests with instrumented full-scale aircraft. Actual spin-tunnel or radio-controlled models are planned for display.

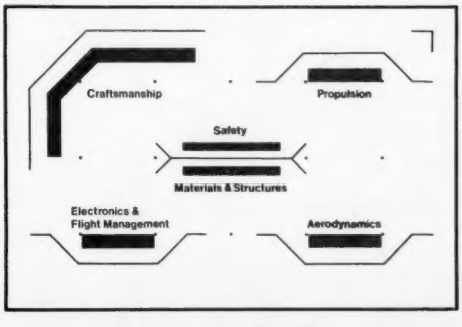
The propulsion section will illustrate the development of aircraft diesel engines, supplemented by an actual engine display. Different facets of propeller design research for high speed efficient flight will be displayed as well as graphics on acoustical research showing current methods of flight testing propellers and measuring their noise levels with internal and external instrumentation.

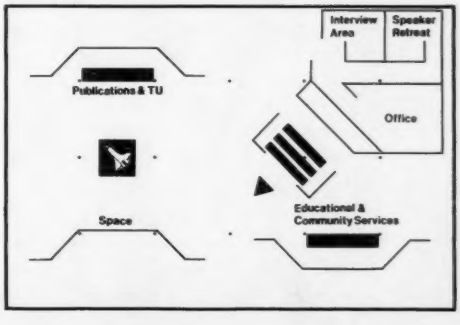
The materials and structures section of NASA's technology exhibit will illustrate aircraft traction drive systems; composite material technology featuring actual pieces of composite and conventional aircraft materials to provide a hands-on demonstration of the weight difference in these materials; and ceramics and protective coatings used in aircraft exhaust systems, also



Design plan for NASA's exhibition at Oshkosh '83. Diagram at page bottom shows layout of the display—one for technology and one for public services—with an "inside view" of the exhibit arrangement for each tent. Photo at left is a top side wide-angle view of the design layout; the Technology tent exhibit is at top of photo; the Public Services tent exhibit is at bottom. Photo below shows close-up of Public Services tent exhibit layout.







adapted foruse in the automobile industry, with a component on display to depict the coating.

Guidance and navigation hardware with supporting graphics of cockpit information systems will be displayed which will illustrate single pilot IFR display, fluidics autopilot, how to sense true airspeed, and a low-cost autopilot. Exhibit panels will depict a variety of NASA's flight simulators and the uses of such technology.

An aircraft cabin floor and seat model section will illustrate NASA's research in crash dynamics to improve safety. Flame retardant and non-toxic materials developed from NASA research also will be displayed as well as a new design for an aircraft icing meter. An actual ice meter also is planned for display. Stall-spin research work also will be featured as part of this exhibit section.

The craftsmanship section will explain how NASA fabricates the models or model aircraft components used in its various aeronautical research programs.

The Public Services tent will feature exhibits on NASA's space program and technology utilization program; a publication area; and NASA's educational and community services programs. The space program exhibit will highlight NASA's Space Transportation (Space Shuttle) System and the future of potential long-term space stations. The technology utilization exhibits include selected samples of spin-offs from NASA research and technology that have provided benefit to the general public at a tiny percentage of the tax dollar.

Personnel will be on hand to assist convention attendees and participants in obtaining NASA publications and information on the teacher resources programs, speaker bureaus, the NASA Spacemobile and Aerovan, and other services offered by NASA. Also included in the Public Services tent will be a small theater dedicated to audio-visual and lecture presentations.

For Oshkosh '83 NASA plans to have on display two general aviation research aircraft: the twin otter and a stall-spin research aircraft. The twin otter, a DeHavilland of Canada DHC-6, is used by NASA's Lewis Research Center, Cleveland, as a flying research laboratory in the center's efforts to learn the cause of aircraft icing. Researchers use the data gathered from wind tunnel simulations and then verify this data through actual flight test conditions using a specially equipped twin otter. There are two types of aircraft ice: glaze ice which is clear like glass; and rime ice which is white and forms only at very cold temperatures. Lewis research crews fly the otter into clouds at altitudes between 10,000 and 20,000 feet to learn how and why these forms of ice collect on the leading edges of aircraft wing and helicopter blades. Inside the clouds, special probes measure the water content, temperatures and other data. Samples of wing ice, snowflakes and water droplets are also collected for study back at Lewis labs.

NASA's stall-spin research has been conducted with fully instrumented single engine light planes to study their spin-stall characteristics. The flight tests have been conducted at NASA's Langley Research Center. The research is designed to develop ways to prevent accident causing stalls and spins as well as other research efforts to define ways to improve overall aerodynamic efficiency; improve crash survivability; and reduce fuel consumption and noise; and exhaust emissions.

Additionally, NASA's Aerovan traveling exhibit unit, will make its second trip to Oshkosh. The walk-through trailer features nine non-technical exhibits on current NASA aeronautical research in safety, energy efficiency, environmental compatibility, and improvements in passenger comfort and safety.

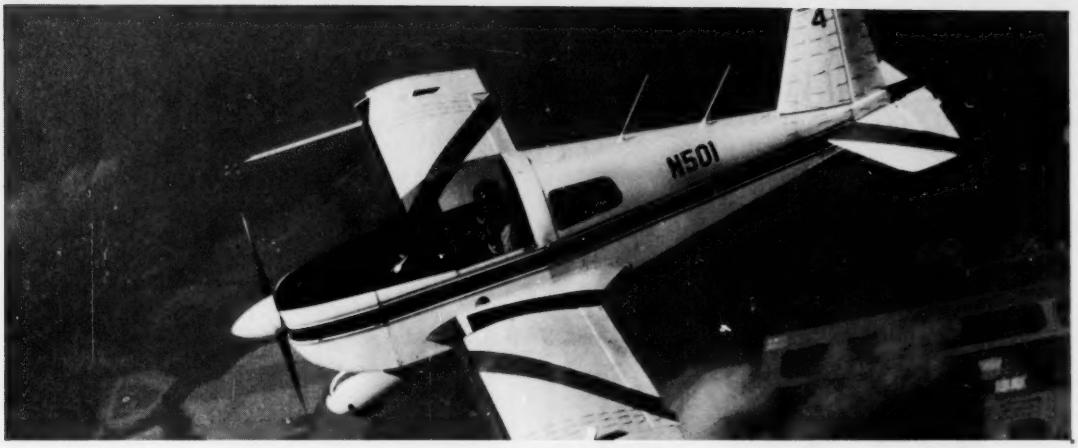
NASA will conduct 25 workshops and forums throughout the eight days of the convention. Participants will represent NASA's three leading centers for aeronautical research: Lewis Research Center, Cleveland, Ohio; Langley Research Center, Hampton, Va.; and Ames Research Center, Moffett Field, Calif. Scheduled speakers and titles of their presentations are:

Lewis Research Center

Harold Sliney—Lubrication and Wear Research
Stuart Lowenthal and Doug Rohn—Advanced Traction Drive Technology for General Aviation
Edward Willis and Jack McFadden—NASA Lightweight Diesel Engine for General Aviation
Phillip Meng—NASA Rotary Engine Program for General Aviation
Tom Miller—Ceramic Materials for Advanced Heat Engines
Richard Ranaudo and Joe Shaw—NASA Aircraft Icing Research
Bob Jeracki—NASA Propeller Aerodynamic Research
Tito Serafini—Composite Materials for Aeropropulsion Applications
Cliff Crabbs—Light Aircraft Icing Conditions
Phillip Meng—Rotary Engines in Flight Applications

Langley Research Center

Hugh Bergeron—NASA Research to Improve General Aviation Instrument Flight Rules
Tom Bonner—Wing-to-Winglet Structural Interface
Phil Brown—Airplane Handling Qualities for the Designer, Builder and Test Pilot



NASA research aircraft to be displayed at Oshkosh '83: (top) stall-spin research aircraft; (bottom) twin otter research aircraft.

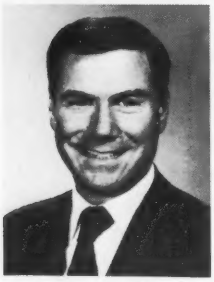
Wayne Bryant—Propeller Design, Personal Computers and You
Anthony M. Busquets and R. F. Hellbaum—Microcomputer Graphics for Cockpit Displays
Joe Chambers—NASA Tests of Unconventional Configurations
Doug Garner—Using Microcompters in Homebuilt Aircraft Instrumentation
Bruce Holmes—Laminar Flow Applications for Practical Airplanes
Homer G. Morgan—Noise Control for Propeller-Driven Aircraft
Rodney Ricketts—Making Your Airplane Safe from Flutter
Dan M. Somers—How to Pick the Right Airfoil
Paul Stough—Increased Spin Resistance Through Wing Leading-Edge Modifications

Ames Research Center

Seth Anderson—Handling Qualities of Canards, Tandem Wings and Flying Wings
Ray Hicks—Airfoil Modification for CL Maximum Lift Improvement
John Parker—Smoke Effects of Toxic Materials

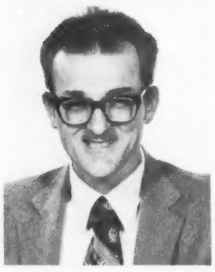
Oshkosh '83 will mark the 12th consecutive year of NASA's participation in Experimental Aircraft Association events and the second year that NASA has provided an extensive exhibit. Total Oshkosh 1983 exhibition area will encompass almost 900,000 square feet of both indoor and outdoor space. Almost 400 technical representatives from aircraft manufacturers, aircraft retail and wholesale parts distributors, and aviation services companies are scheduled to participate.

New Headquarters Appointments



Patrick A. Templeton has been appointed NASA Headquarters **Associate Administrator for External Relations,** replacing Robert F. Allnutt, who had been serving in that position in an acting capacity. Allnut left NASA in May to become the legal counsel to the U.S. Committee for Energy Awareness. Prior to this new appointment, Templeton had served as Deputy Assistant Administrator for Legislative Affairs, NASA Headquarters, since September 1981. In his new position, Templeton will be responsible for policy level management, direction and coordination of the agency's relationships with external organizations, both public and private. This includes the news media, the Department of Defense and other federal agencies, state and local governments, industry and private individuals. He also will serve as principal advisor to the Administrator and other senior officials on matters pertaining to NASA's external relations activities.

Before joining NASA, Templeton had been manager of Government and Community Relations for the Major Appliance Business Group of the General Electric Co., Louisville, Ky. Prior to that he served as manager of Government Relations for General Electric's Transportation and Communications Systems Divisions in Washington, D.C. He joined General Electric in 1965 in the sales management program.



Dr. Francis X. Hurley has joined NASA Headquarters as **Deputy Chief Scientist.** His principal responsibilities will be in aeronautics. Prior to his NASA assignment, Hurley served as Manager of Research and Technology for the Fort Worth division of General Dynamics. From August 1976 to June 1977 he was an American Institute of Aeronautics and Astronautics Congressional Fellow assigned to the office of U.S. Representative Jack F. Kemp. Prior to that time he spent eight years with the McDonnell Douglas Research Laboratories.

Dr. George H. Ludwig has joined the Office of the Chief Scientist, NASA Headquarters, as **Assistant for Space Research Data Management.** In this position, he will review existing NASA policies and practices for the acquisition of space data, and the distribution, processing and archiving of this data for research purposes.

Prior to this assignment, Dr. Ludwig had served as Director of the National Oceanic and Atmospheric Administration's Environmental Research Laboratories in Boulder, Colo., since 1981. He first joined NASA with the Goddard Space Flight Center in 1960 as Associate Director for Data Operations, and was Chief of the Data Processing Division when he left in 1972 to join NOAA as Director of Operations for the National Earth Satellite Service. A co-discoverer of the Van Allen Radiation Belts, Ludwig also designed, supervised the construction of, and tested the scientific instrumentation for Explorers I, II, and III.

NASA Reopens Astronaut Recruitment

This fall NASA will initiate what is expected to become an annual selection of Space Shuttle astronauts. For the Fall 1983 candidacy, NASA anticipates openings for six pilots and six mission specialists in this selection, and has an affirmative action goal of including qualified minorities and women among the newly-selected candidates. America's first woman astronaut in space, Sally K. Ride, flew aboard the seventh Space Shuttle mission in June.

Pilot astronauts are responsible for control of Space Shuttles during launch, reentry and other required maneuvers, and for maintenance of flight systems. Mission specialist responsibilities include management and operation of Shuttle systems which support payloads during flight.

Applications from civilians will be accepted from Oct. 1 to Dec. 1, 1983. Selections will be made in the spring of 1984 and successful candidates will report to work that summer. In late May, the military services began their process of screening candidates for nomination to NASA.

The number of candidates recruited in subsequent selection periods will vary, depending upon mission

requirements and the rate of attrition in the existing astronaut corps.

Minimum qualifications for pilot astronauts are:

- A bachelor's degree from an accredited institution in engineering, biological or physical science, or mathematics;
- At least 1,000 hours time as pilot in command of high performance jet aircraft—flight test experience is highly desirable;
- Ability to pass a NASA Class I space flight physical examination which is similar to military and civilian flight physicals;
- Height between 64 and 76 inches.

Minimum qualifications for mission specialist astronauts are:

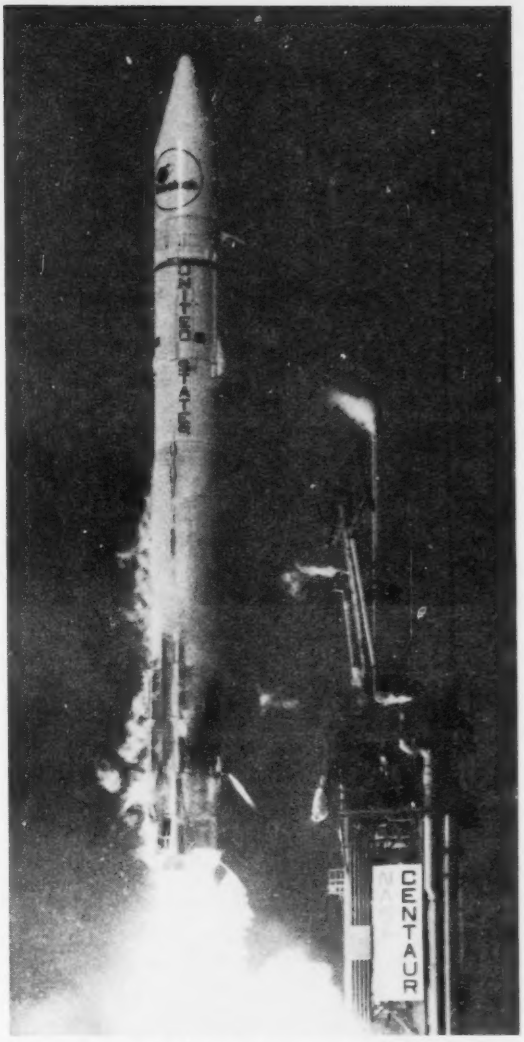
- A bachelor's degree from an accredited institution in engineering, biological or physical science, or mathematics;
- Degree must be supplemented by at least three years related professional experience. An advanced degree is desirable and may be substituted for the experience;
- Ability to pass a NASA Class II space flight physical examination, which is similar to military and civilian flight physicals;
- Height between 60 and 76 inches.

Enterprise Returns Home

Space Shuttle orbiter Enterprise has returned to Edwards Air Force Base, California after a four-week whirlwind international tour that brought the spacecraft, mated atop NASA's 747 Shuttle Carrier Aircraft, to five major cities in five countries, with a concluding stop in the nation's capital in Washington, D.C. The highlight of the Enterprise tour was its exhibition at the Paris Air Show May 25 through June 5.

Enterprise began its tour on May 16, departing Edwards for Peterson Air Force Base, Colorado Springs, Colo., for its first public relations stop. The Enterprise remained on display at Peterson through May 17. Accompanying Enterprise throughout its tour stops was NASA Headquarters public information officer James Kukowski, who coordinated public relations and press activities.

On May 18, Enterprise left for McConnell Air Force Base, Wichita, Kansas, for a refueling stop and



100th Lewis Launch—Intelsat V-F, the sixth of a new series of nine communications satellites owned by the 105-member nation International Telecommunications Satellite Organization was successfully launched May 20, 1983 at 6:26 p.m. EDT from Eastern Space and Missile Center, Cape Canaveral, Fla., aboard an Atlas Centaur expendable launch vehicle. Once in geosynchronous orbit, Intelsat V-F will be the first Intelsat equipped with a maritime communications system for ship to shore communications. The satellite also has double the communications capability of earlier satellites in the Intelsat series, with its 1,200 voice circuits and two color television channels. This launch marked the 100th launch by engineers of NASA's Lewis Research Center, Cleveland, Ohio. Lewis has management responsibility for Atlas Centaur development and operations. NASA's Kennedy Space Center, Fla., is assigned vehicle checkout and launch responsibility once the Atlas Centaur reaches Cape Canaveral.

Space Shuttle orbiter Enterprise after rollout from Rockwell International's Palmdale facility in California on Sept. 17, 1976.

departed hours later for another refueling and overnight stop at Wright-Patterson Air Force Base, Dayton, Ohio.

On May 19, Enterprise departed Ohio and arrived at Goose Bay, Labrador, Canada for refueling. From Goose Bay, Enterprise was scheduled to make stops at Keflavik Naval Air Station, Iceland, and Fairford Royal Air Force Base, England, before arrival at its destination of Le Bourget Airport, Paris, for a 10-day exhibition at the Paris Air Show. Preceding Enterprise from Goose Bay to Keflavik and from Keflavik to Fairford was a "pathfinder" aircraft—a Navy P-3 patrol plane (a Lockheed Electra transport). This aircraft took off approximately one half hour ahead of the scheduled departure of Enterprise to scout flight path weather conditions. Upon approval from the P-3 pilot, the Enterprise/747 assembly departed for Keflavik and for Fairford.

The P-3 escort was used as a precautionary measure for the Enterprise's journey over large bodies of water—transporting Enterprise was NASA's only 747 Shuttle Carrier Aircraft, also used to transport Space Shuttles Columbia and Challenger from Edwards to Kennedy Space Center for flight-readiness processing.

Enterprise arrived at Keflavik on May 19 where it remained overnight. On May 20, the spacecraft/aircraft assembly journeyed to Fairford Royal Air Force Base, England, where it was refueled for its final destination that afternoon of Bonn/Cologne, Federal Republic of Germany. The spacecraft/aircraft assembly was displayed from May 21 through May 23 in Bonn/Cologne, and then departed mid-morning of May 24 for Paris, France, where it remained on display from May 25 through June 5 at Le Bourget Airport as the highlight of the U.S. aerospace exhibit at the Paris Air Show.

Enterprise left the Paris Air Show the afternoon of June 1 for Rome, Italy, for a one-day state visit; the spacecraft/aircraft assembly then returned to the Paris

Air Show on June 2. On June 5, Enterprise departed Paris for Stansted Airport near London, England, where it remained on display through June 6. The following morning, preceded by the Navy P-3 escort aircraft, Enterprise left for Keflavik, Iceland, for refueling, and departed behind the P-3 the next day for Goose Bay, Labrador, Canada, for another refueling stop. It arrived at its final Canadian destination of Ottawa late in the afternoon of June 8 where it remained on display through the afternoon of June 10.

For the final stop on its tour, Enterprise was flown into the nation's capital, Washington, D.C., at Dulles International Airport on June 12. On the morning of June 13, the spacecraft/747 assembly returned to Edwards Air Force Base, Calif., making a refueling stop at Shepard Air Force Base, Wichita Falls, Texas.

NASA's next assignment for the Enterprise will be to assist the Air Force in fit checks of its mobile transporter and launch pad facilities at Vandenberg Air Force Base, California—the site of future Space Shuttle polar orbit flight launches. Enterprise was used as a test vehicle in 1977 for a series of approach and landing flights at Edwards and for launch facilities checks at Kennedy Space Center, Fla.

NASA Inventor of the Year for 1982

Dr. Joseph S. Heyman, researcher at NASA's Langley Research Center's Instrument Research Division, Hampton, Va., has been named **NASA Inventor of the Year for 1982.** Heyman received the award for his invention of an ultrasonic (very high acoustic frequency) instrument called a pulsed-phase, locked loop strain monitor. The instrument can precisely measure changes in acoustic propagation time with application to residual stress in materials; material curing, such as composites; and measuring thickness variations in materials.

"We are primarily interested in materials characterization for non-destructive examination," Heyman said. "The instrument allows a material to vibrate at its own natural frequency. By measuring this natural frequency, we can determine properties of the material, such as the elastic constants, the thickness or the composite's curing state, so that it can be examined. From that, we can tell if the material is properly made or in a proper state—the amount of stress placed on the material—with the ultimate goal of extending the 'safe life' of the material. Such a science base could prove invaluable in operational monitoring of space platforms, for instance."

Dr. Joseph S. Heyman (left), NASA Inventor of the Year for 1982, receives this award from Langley Research Center's Director, Donald P. Hearth. Heyman received the award for inventing an ultrasonic instrument named a pulsed-phase, locked loop strain monitor.

Heyman said that the instrument is about one thousand times more sensitive than any other ultrasonic measurement. He considers it a major breakthrough and is now building a multiple pulsed-phased loop for imaging. "We will be able to take a material and get a picture, painted in the light of those same properties, for further examination," he explained.

Heyman has received numerous awards for his research, including the IR-100 award, presented by Industrial Research Development Magazine for each of the 100 most significant technical developments of the year. He is the first person in the history of the award to receive four IR-100s—in 1974, 1976, 1978 and 1981. He was presented the Arthur S. Flemming Award by the Downtown Jaycees of Washington, D.C., as one of 10 outstanding young federal government employees of 1981. He was presented a NASA Exceptional Service Medal and a Langley Technology Transfer Award in 1979.

A native of New Bedford, Mass., Heyman graduated from Tabor Academy in 1961. He attended Cornell University and Northeastern University, Boston, where he received a bachelor's degree with honors in physics in 1968. He earned master's and doctorate degrees from Washington University, St. Louis, in 1971 and 1975, respectively. In 1979 he was appointed adjunct professor of physics at the College of William and Mary.

Heyman began his NASA career as a cooperative education student in 1964. He is a research physicist and head of the Materials Characterization

Instrumentation Section, where he coordinates a basic research program in ultrasonic interactions in materials and a program of applications of ultrasonic techniques to materials physics, solid state physics and electronic materials.

The author or co-author of more than 100 technical publications and presentations, Heyman holds 13 patents. He is a member of numerous professional organizations including: the American Physical Society, the American Association for the Advancement of Science, and the Society for Experimental Stress Analysis.

What's New in NASA Television and Radio Programming

Programs released in June (and July for radio):

Television:

Aeronautics and Space Report (14½ minutes) **Space Shuttle . . . Flight 7**

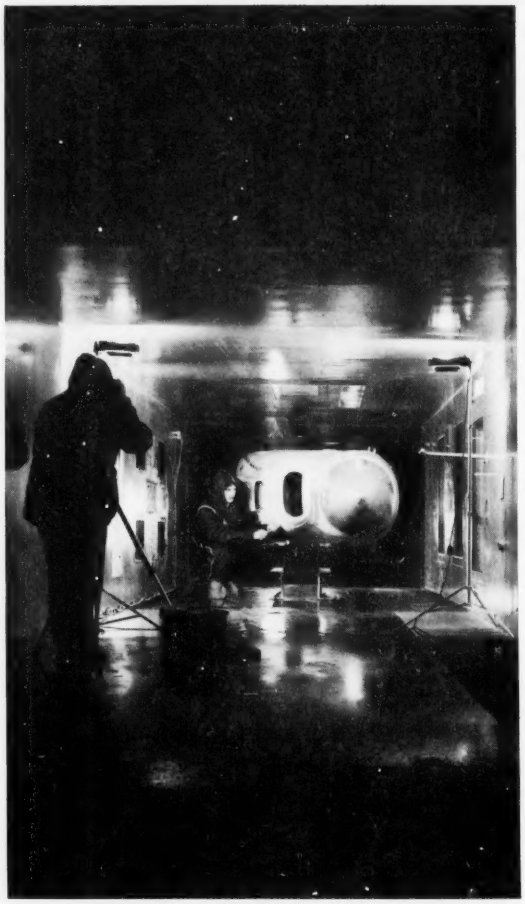
Radio (for June):

Space Shuttle Seven . . . A Coed Flight (14½-minute monthly report; featuring the STS-7 crew, Johnson Space Center)
Reviving the Propeller Driven Aircraft (4½-minute weekly report; featuring Robert Jeracki, Lewis Research Center)
Space Shuttle Seven . . . A New Phase in Flight (4½-minute weekly report; featuring Robert Crippen and Sally Ride, Johnson Space Center)
The Stall-Spin Effect in Aircraft (4½-minute weekly report; featuring James Patton, Langley Research Center)
The Crash Test Program (4½-minute weekly report; featuring Huey Carden, Langley Research Center)

Space Notes (1 minute each; playing through August)
Lunar Rocks Found on Earth
AXAF . . . A Look into the X-Ray Sky
Pioneer Leaves the Solar System
Dramatic New Discoveries with IRAS
Deep Into Space with Space Telescope
Space Technology Used on Sunken Ships
Advanced Propeller Research
Laboratory in Space
Rocket Experiments in Peru
Space Shuttle Seven

Copies of television tapes are sent simultaneously to all NASA Visitor Information Centers and Public Affairs Offices, and to 650 television stations nationwide as well as to 425 cable television systems via the satellite SATCOM 1-R. Five hundred television stations receive material formatted as a 4½-minute program; the remaining 150 stations receive a 90-second "spot"—a condensed version of the 4½-minute presentation.

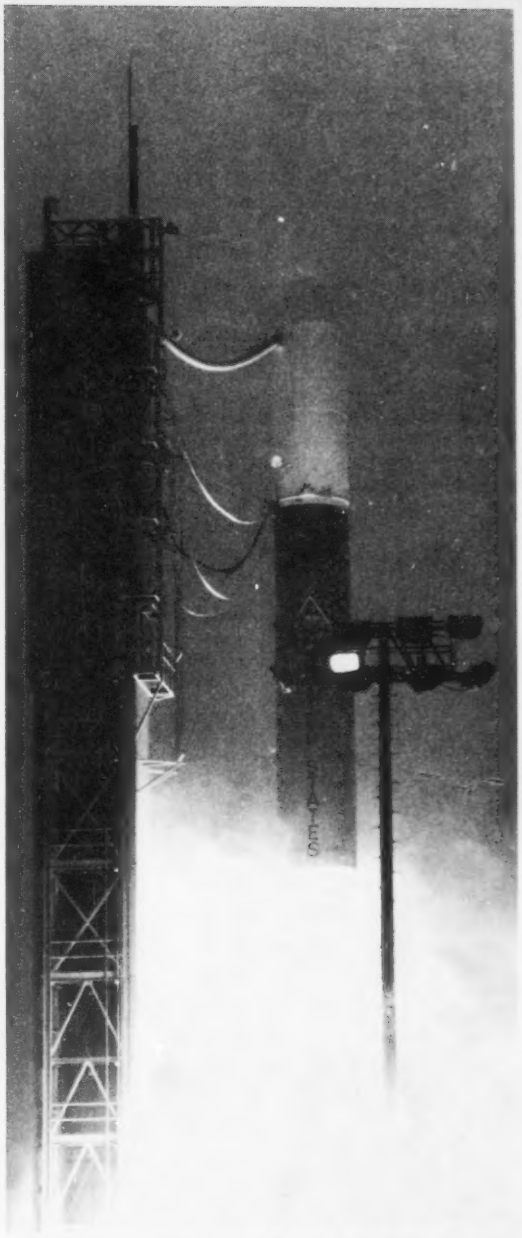
NASA's radio programs are sent to over 2,000 radio stations across the nation; in addition, translations of the recordings are made by Voice of America and Radio Free Europe and these tapes are then released to the appropriate audiences overseas. Released each month are one report of 14½ minutes and four 4½ minute weekly stories (one story in the set is featured for one week of the month). Ten one-minute space notes are released quarterly.



Aircraft Icing Research—Formation of ice on aircraft surfaces represents a serious problem in both civilian and military aviation. As part of Lewis Research Center's continuing investigation of the icing phenomenon, a turboprop engine is tested in Lewis' icing research tunnel. The engine, which powers a plane similar to NASA's Gulfstream, is mounted horizontally so it can be pivoted to simulate varying angles of attack that might be encountered during a typical flight under icing conditions.

NASA's 25th Anniversary, Oct. 1, 1983
Historical Calendar for July

Date	Event
July 1, 1966	Launch of Explorer XXXIII (33)
July 2, 1965	Launch of Tiros X (10) (OT-1)
July 4, 1968	Launch of Explorer XXXVIII (38)
July 5, 1966	Launch of Apollo Saturn 203
July 8, 1971	Launch of SOLRAD-10 (NRL) (Explorer 44)
July 8, 1976	Launch of Palapa-A (1)
July 9, 1979	Voyager 2 flyby of Jupiter
July 10, 1962	Launch of Telstar 1 A-Epsilon 1
July 12, 1961	Launch of TIROS III
July 12, 1966	First flight in wingless lifting body to demonstrate man's ability to safely land a craft designed to re-enter the Earth's atmosphere
July 14, 1965	Mariner 4's first closeup photos of Mars
July 14, 1967	Launch of Surveyor IV
July 14, 1978	Launch of GOES-B/ESA
July 15, 1972	Pioneer 10 passed through asteroid belt
July 15, 1975	Launch of Apollo/Soyuz Test Project
July 16, 1969	Launch of Apollo 11
July 16, 1973	Launch of ITOS-E (NOAA)
July 16, 1982	Launch of Landsat-D
July 17, 1975	First Apollo Soyuz Test Project rendezvous
July 18, 1966	Launch of Gemini X (10)
July 19, 1967	Launch of Explorer XXXV (35)
July 20, 1964	Launch of SERT-1
July 20, 1969	First lunar landing
July 20, 1976	Viking 1 lands on Mars
July 21, 1961	Launch of Mercury Redstone 4 (Liberty Bell 7; G. Grissom)
July 22, 1962	Launch of Mariner 1 (P-3)
July 22, 1976	Launch of Comstar B (2)
July 23, 1970	Launch of Intelsat III F-8
July 23, 1972	Launch of ERTS-A (1) (Landsat 1)
July 26, 1963	Launch of Syncom II (2)
July 26, 1971	Launch of Apollo 15
July 28, 1964	Launch of Ranger VII (u)
July 28, 1967	Launch of OGO-IV
July 28, 1973	Launch of Skylab 3
July 29, 1958	Space Act Signed
July 29, 1960	Launch of Mercury (MA-1) suborbital
July 29, 1960	Project Apollo announced
July 29, 1976	Launch of ITOS-H (NOAA-5)
July 30, 1965	Launch of Pegasus III (3)

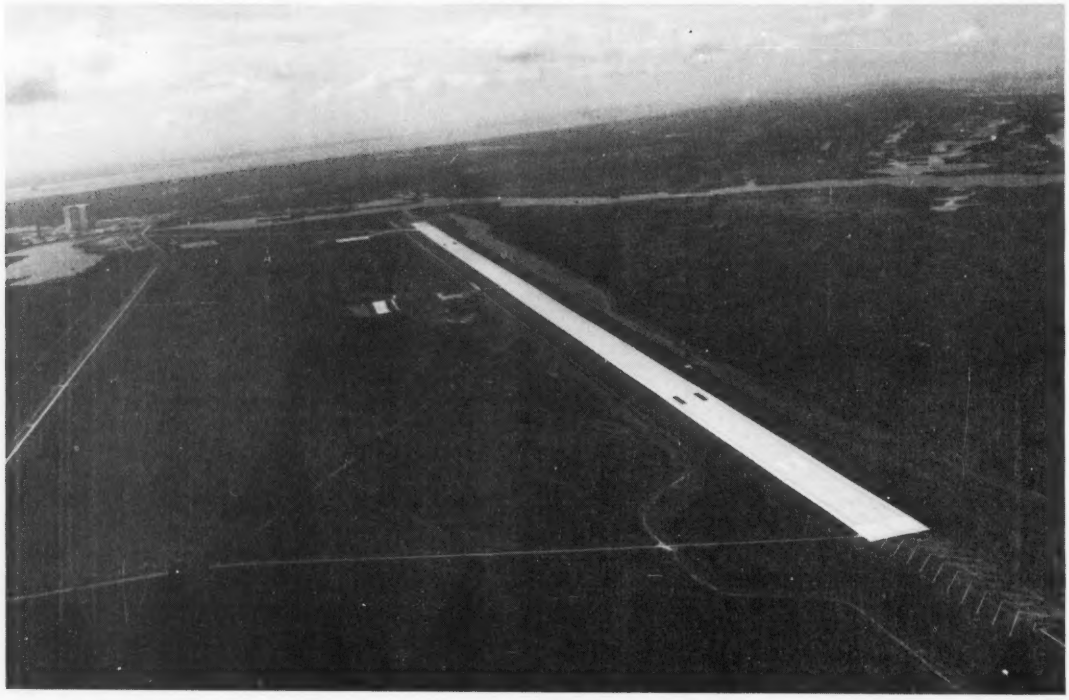


EXOSAT launch—NASA successfully launched EXOSAT (European X-Ray Observatory Satellite) for the European Space Agency on May 26, 1983 from Western Space and Missle Center, Vandenberg Air Force Base, Calif., at 8:18 a.m. PDT aboard a Delta 3914 expendable launch vehicle. The 1,125-pound satellite will make a detailed study of the precise position and characteristics of known X-ray sources and will search the skies for new sources.

Contractor News

U.S. Aircraft Sales, Inc., McLean, Va., has been awarded a firm fixed-price contract by NASA's Johnson Space Center, Houston, for NASA's lease, with an option to buy, of a used Grumman Gulfstream II for eventual conversion into a third Shuttle Training Aircraft. Full inspection and system analysis will be performed on the aircraft during the lease period, after which NASA intends to exercise the purchase option and begin modifications. The proposed lease-purchase price of the aircraft is $6.9 million. The twin turbojet aircraft will join two other Shuttle Training Aircraft purchased from the Grumman Aerospace Corporation in January 1974. Shuttle Training Aircraft Gulfstreams are extensively modified to exhibit the same handling characteristics as a Space Shuttle during the steep descent and final approach regimes of Shuttle flights.

Holloway Corp., Titusville, Fla., has been awarded a $1.4 million contract for providing labor equipment and materials to modify Solid Rocket Booster Refurbishment Subassembly Facilities located in the Vehicle Assembly Building (VAB) and hangar N at Cape Canaveral Air Force Station. The fixed-price contract was initiated mid-April 1983 and extends to mid-November 1983. Work in the VAB will be in the low bay where the boosters are currently processed. The work area in two bays will be expanded toward the transfer aisle to make room for more equipment. New controlled temperature cure booths, which solidify and dry the insulation sprayed on booster nose cones, forward skirts, forward frustrums and aft skirts, will be installed in Cell 3 of the VAB. The floor surface will be



Shuttle 7 Landing Scene—Aerial view of Shuttle Landing Facility at NASA's Kennedy Space Center, Fla., where Space Shuttle Challenger was to make its debut Florida landing for the seventh Space Shuttle flight. The runway measures 4,572 meters (15,000 feet) long, 91 m (300 ft.) wide, and has a 305-m (1,000 ft.) safety overrun at each end. The Shuttle Landing Facility is roughly twice as long and twice as wide as an average commercial landing facility. The runway is 40.6 centimeters (16 inches) thick at its center with the thickness diminishing to 38 centimeters (15 inches) on the sides. The concrete has been grooved to prevent hydroplaning in wet weather. At the northeast corner of the landing strip is the mate/demate device used to raise and lower the Space Shuttle orbiter from the 747 Shuttle Carrier Aircraft.

reconditioned to facilitate movement of air-bearing pallets used in these cells. A building will be provided just southwest of the VAB for storing processing materials. New clean booths and tube bending and cleaning facilities will be installed in Hangar N for processing booster aft skirts.

And in further contract news from NASA's Kennedy Space Center, Fla:

NASA has announced it will recompete the Booster Assembly Contract which encompasses the refurbishment, assembly and checkout of Space Shuttle solid rocket boosters (exclusive of the solid rocket motors which are under a separate contract to Morton Thiokol, Inc.). The decision reflects NASA's efforts to find, through the competitive bidding process, the most effective and efficient means of processing the boosters and moves the space agency toward the goal of reducing the cost-per-flight of the Space Shuttle. The successful bidder will be required to construct a Space Shuttle Rocket Booster Refurbishment Facility on-site at the Kennedy Space Center to perform solid rocket booster operations currently conducted in the low bay of the Vehicle Assembly Building and other outlying facilities. This new facility will ultimately become the property of the U.S. Government. The first production hardware from the facility should be available about early 1986. A request for proposals should be released in Fall 1983 with the successful bidder expected to be on-board about mid-year 1984. Prospective bidders will be invited to send on-site assessment teams to NASA's Kennedy Space Center to view current processing activities to aid in the preparation of the bids. Work under the current Booster Assembly contract is performed by United Space Boosters, Inc., Huntsville, Ala., under the direction of NASA's Marshall Space Flight Center.

Dynair Electronics, Inc., San Diego, Calif., has been awarded a $1.2 million contract by NASA's Kennedy Space Center for support of Space Shuttle payload processing operations at Kennedy and at Vandenberg Air Force Base, Calif. The fixed-price contract provides for the design, manufacture, fabrication, installation and testing of a combination digital data and video bandpass routing switcher to be used in transmitting data which validates electrical interfaces between the Shuttle orbiter and its payloads. This system is to be completed and operational at both installations by March 15, 1984.

PRC Systems Service Company and **Briel, Rhame, Poynter and Houser,** Cocoa Beach, Fla., have been awarded a $1.6 million joint venture fixed-price contract by NASA's Kennedy Space Center to provide architectural and engineering services for integrated systems documentation in support of modifications being made to Launch Pad 39B. This launch pad will be used to launch NASA's Space Shuttle in the mid 1980s. Under terms of the contract, this documentation will include schematic diagrams of the layout of electrical and mechanical systems, and cabling and equipment interfaces which will aid in the maintenance and operation of the launch pad. The contract covers the period from May 17, 1983 through June 30, 1984.

NASA's Goddard Space Flight Center, Greenbelt, Md., has awarded the following two contracts:

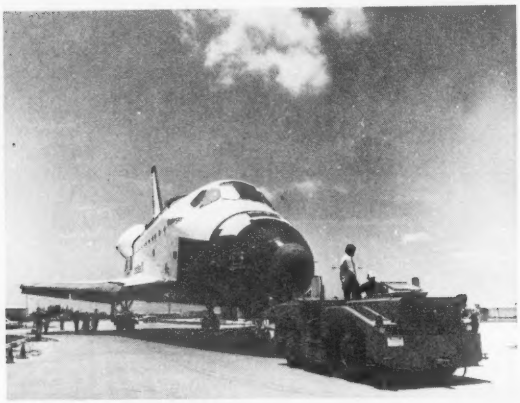
A $42.4 million contract to **Science Applications Research,** Riverdale, Md., to provide computer programming and analysis in support of Goddard's applications and sciences directorates. The contract, to run approximately five years, calls for an initial award for 3 years of $24.6 million with a two-year option; total value of the contract award is approximately $42.4 million. Science Applications Research is a joint venture of Systems and Applied Sciences Corp., and Republic Management Systems, of Riverdale, Md. Work on this contract is scheduled to begin Aug. 1, 1983.

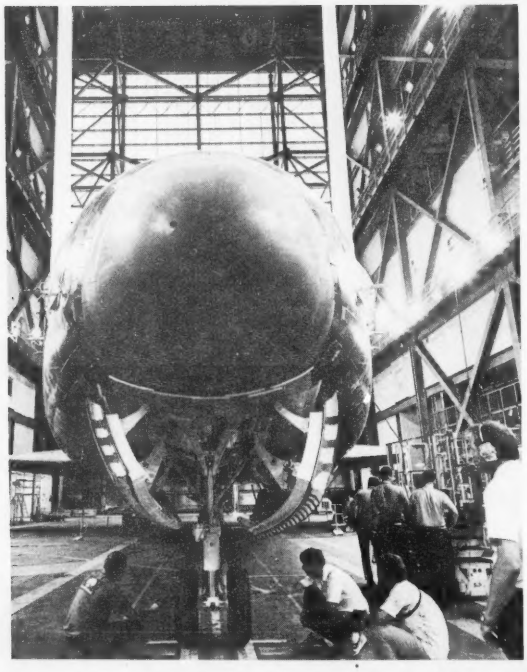
A $1.6 million cost-reimbursement contract to the **University of California at Berkeley** for implementation phase work on the Cosmic Background Explorer project. Under terms of the contract, the University is to develop differential microwave radiometer activities, conduct laboratory studies of microwave hardware and develop pre-launch data requirements and post-launch data analysis for the Cosmic Background Explorer project. Cosmic Background Explorer is scheduled to be launched from the Space Shuttle in Oct. 1987 and will be designed to measure background radiation in space which could confirm the "Big Bang" theory of creation of the universe. This contract began May 1, 1983 and runs until Dec. 31, 1989; work is conducted by the Lawrence Berkeley Laboratory at the University.

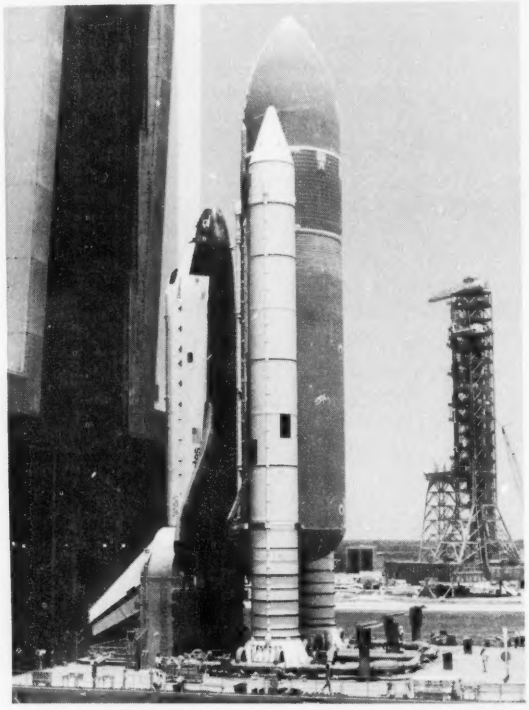
Space Shuttle Launches for 1983

Orbiter	Launch Date	Launch Number	Launch Site	Payload
*Challenger (OV-099)	April 4	6	KSC	TDRS-A
*Challenger (OV-099)	June 18	7	KSC	OSTA 2; SPAS-01 Telsat-F; Palapa B-1
Challenger (OV-099)	August	8	KSC	INSAT 1-B; PDRSTA
Columbia (OV-102)	September 30	9	KSC	Spacelab 1
Challenger (OV-099)	December 14	10	KSC	DOD 84-1

*Successful launch







Space Shuttle 7 Pre-launch—Views of rollover (left) and rollout of Space Shuttle Challenger for the seventh Space Shuttle mission flight in June. At top left, Challenger was transferred from the Orbiter Processing Facility at Kennedy to the Vehicle Assembly Building on May 21 (the rollover) where the orbiter was mated with the external tank and twin solid rocket boosters. Rollout to the launch pad occurred just five days later, on May 26. Photo at bottom left is dramatic front view of Challenger in the transfer aisle of the Vehicle Assembly Building following the rollover.

Patents for Inventions from NASA Research

The Office of General Counsel, NASA Headquarters, announces the following U.S. patents have been issued by the U.S. Patent and Trademark Office to NASA for inventions resulting from NASA research. Inquiries concerning them should be directed to the attention of the NASA Patent Counsel of the indicated installation.

Inventor(s) & Employer	Title	Patent No.	Installation
George F. Von Tiesenhausen, NASA/MSFC	Beam connector apparatus and assembly	4,381,583	MSFC
Philip A. Studer, NASA/GSFC	Magnetic bearing and motor	4,381,875	GSFC
Charles H. Bell, NASA/KSC	Fiber optic crossbar switch for automatically patching optical signals	4,381,881	KSC
Randall F. Gahn, Margar A. Reid, and Chiang Y. Yang, NASA/LeRC	Zirconium carbide as an electrocatalyst for the chromous/chromic redox couple	4,382,116	LeRC
Emmett L. Miller, Caltech/JPL	Electronic system for high power load control	4,382,224	NRO/JPL
Bill C. J. Chen and Robert W. Hartop, Caltech/JPL	Waveguide cooling system	4,382,239	NRO/JPL
Mahadeva P. Sinha, Charles E. Giffin, David D. Norris, and Sheldon K. Friedlander, Caltech/JPL	Particle analyzing method and apparatus	4,383,171	NRO/JPL
Pramode K. Bhagat and Vic C. Wu, University of Kentucky, Lexington	Apparatus for determining changes in limb volume	4,383,533	JSC

Expendable Launches for 1983

Name	Launch Date	Vehicle	Range	Mission Remarks
*IRAS	January 25	Delta	WSMC	Infrared astronomy. NASA scientific.
*NOAA-E	March 28	Atlas-F	WSMC	NOAA weather and SARSAT. Reimbursable.
*RCA-F	April 11	Delta	ESMC	RCA communications. Reimbursable.
*GOES-F	April 28	Delta	ESMC	NOAA weather. Reimbursable.
*Intelsat V-F	May 19	Atlas Centaur	ESMC	Intelsat communications. Reimbursable.
*EXOSAT	May 26	Delta	WSMC	European Space Agency. Reimbursable.
Galaxy-A	June 28	Delta	ESMC	Hughes Communications, Inc. Reimbursable.
HILAT	June 28	Scout	WSMC	Air Force research and development. Reimbursable.
Telstar 3-A	July 28	Delta	ESMC	AT & T communications. Reimbursable.
RCA-G	August 25	Delta	ESMC	RCA communications. Reimbursable.
Galaxy B	September 22	Delta	ESMC	Hughes Communications, Inc. Reimbursable.
NAVY-21	4th quarter	Scout	WSMC	DOD transit. Reimbursable. Call up.
San Marco D/L	November	Scout	SMR	International cooperative/Italy.
AF-1	December	Scout	WFC	Air Force development program. Reimbursable.

*Successful launch

Note: At reader request, following is a brief explanation of terms used in the Launch Schedules: WSMC—Western Space and Missile Center, Vandenberg Air Force Base, Calif.; ESMC—Eastern Space and Missile Center, Cape Canaveral Air Force Station, Fla.; SMR—San Marco Range, off the east coast of Kenya, Africa; WFC—Wallops Flight Center, Wallops Island, Va.; KSC—Kennedy Space Center, Fla. *Reimbursable* expendable launches means that NASA is compensated or repaid for launch expenses incurred by the company or agency whose payload is launched. *Call up* indicates that the launch vehicle and spacecraft are in flight status and have been placed on standby, awaiting final preparations for launch based on the customer request for a launch time and date within a period of time not to exceed 120 days.

Another Dividend from Air and Space

Research and development in aeronautics and space have provided numerous benefits for all Americans—and at a tiny percentage of the tax dollar. Here is an example:

Injury Reducing Seat Design

A new load-limiting design that could be used in aircraft of automobile seats has been developed at NASA's Langley Research Center that will reduce the injury risk to seat occupants in the event of a crash.

Developed by Dwight G. McSmith, the Yielding Torque-Tube System* limits the combination of longitudinal and vertical impacts transmitted to the seat and its occupant in a crash situation. Reaction to these forces causes the seat occupant to move forward and downward, often with serious injury as a result. When a load-limiting torque-tube system is properly integrated into the seat structure, the torque tube maintains a relatively constant resistance to applied force for many degrees of rotation.

By properly sizing and selecting material for the yielding torque-tube system, it is possible to limit the loads to the occupant throughout the allowable movement of the seat. By placing the yielding torque tube as a pivot point for the legs of the seat, load response can be controlled in predictable way. A wide variety of seat-support configurations is possible by using this load-limiting design. The design is very compatible with present and anticipated seat construction techniques, is lightweight, shows smooth response under load, and is not sensitive to temperature. The yielding torque-tube system is expected to find applications in the automobile and aircraft industries.

*NASA does not endorse commercial products developed as a result of its Technology Utilization or Patent Licensing Programs, but it does encourage the widest possible use of its technology. Inquiries concerning rights for the commercial use of this invention should be addressed to the Patent Counsel, Langley Research Center, Hampto Va. 23665. In your inquiries, refer to number LAR-12801.

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